Assignments on Uniform flow

1. A concrete-lined, trapezoidal, irrigation canal has a bottom width of 10m, side slopes of 1H: 1V, and longitudinal bottom slope of 0.0005. If the canal is several kilometers long, determine the flow depth near the downstream end for a flow of 60 m^3/s.
2. Prove that the most efficient cross sections for a given flow area are as follows:

   Triangular section: vertex angle = 90^o

   Trapezoidal section: half hexagon
3. Prove that a semi-circle with its center at the middle of the water surface is the most efficient cross section.
4. Explain the variation of hydraulic radius R, Section factor Z, and Conveyance K with respect to depth for deep rectangular channel, circular channel, Trapezoidal and Triangular channel.
5. Define hydraulic exponent of channel. Find out the hydraulic exponent of rectangular and triangular channel.
6. Develop a relationship between chezy's coefficient, Manning's coefficient and Darcy's coefficient.
7. Define conveyance and section factor for the open channel. Also prove that hydraulic radius is equal to depth of flow for wide rectangular channel and half of the bed width for deep gorges.
8. Explain the condition for maximum discharge and maximum velocity in a channel of second kind (closed channel, running partially full). Analyze the condition required to have (a) maximum discharge and (b) maximum velocity in a circular channel of diameter D. (check with Chezy's and Manning's equation)
9. A triangular shaped duct (closed triangular channel) is carrying water with a free surface and in uniform flow mode. Obtain the condition for maximum discharge when the numerical side slopes is (a) z=0.5 (b) z=0.25
10. A boulder-lined drainage channel overflowed its banks during a spring runoff for flows exceeding 20 cfs. The channel is 15 ft wide, is rectangular in shape, and

drops 10 ft/mile. If you are the design engineer, what will be your options to prevent flooding for this flow?

11. Is the flow subcritical or supercritical in a 4-m wide rectangular channel for a discharge of 9 m^3/s. The bottom slope is 0.005 and n = 0.014.
12. Compute the critical and normal depths in a trapezoidal channel (bottom width = 20 ft, side slopes = 1.5 H : 1V) for a flow of 220 ft3/sec. The bottom slope is 0.00032 and n = 0.022. Is the flow subcritical or supercritical?
13. The flow depth for a discharge of 15 m^3/s in a long canal having a trapezoidal cross section (bottom width = 10 m; side slopes = 1V: 2H) is 2 m. If the discharge is increased to 20 m^3/s, what will be the flow depth?
14. The crest of a 10-m wide long rectangular chute spillway is at El. 120 m. The water level upstream of the spillway is at El. 123 m. The bottom slope of the chute is 1 in 400 and Manning n is 0.013.
    i. Determine the discharge in the channel and the entrance flow depth.
    ii. Compute the flow depth at the downstream end of the chute.
15. Show that a trapezoidal channel with given area and side slope Z:1 is most efficient when hydraulic radius is half the depth of flow.
16. A rectangular channel is to carry 2.0 m3/s discharge of water at a slope of 0.0001 and Manning's n of 0.016. If it is designed as the most efficient section. Determine its dimension.
17. Show that, for a circular conduit running part full, R is maximum for given A when y=0.813 D, where D is the conduit diameter.
18. A 3.0 m wide rectangular channel carries 2.4 m3/s discharge at a depth of 0.70 m.
    i. Determine specific energy at 0.7 m depth
    ii. Determine the critical depth.
    iii. Is the flow subcritical or supercritical?
    iv. Determine the depth alternate to 0.7 m
    v. If Manning's n is 0.015, determine the critical slope.
19. A 20 m wide rectangular channel has a (Fig. 1) has a normal depth of 2.5 m when bottom slope is 0.0006 and Manning's n is 0.015. Two piers of 2 m width

each and 4 m long with rounded nose are constructed in the channel as foot bridge for crossing of pedestrian. What will be the afflux (rise in water depth) upstream of piers?